

## DESCRIPTION OF THE PLATES.

## PLATE V.

- Fig. 1. *Fungia echinata*. Fracture across the coral, showing palisade-like septa, cribriform septa, perforations in the base-wall, and long curved synaptica.  $\times 2$ .
2. Ditto. The same, with imperfect synaptica.  $\times 2$ .
3. *Fungia scutaria*, var. Fracture across the coral, showing strong nearly vertical and curved synaptica and solid and cribriform septa.
4. Section tangential to the circumference of the same specimen, showing the synaptica cut across in various parts of their course.
5. View of surface of coral, showing the tops of the synaptica in the interseptal loculi.
6. The direction of the ultimate fibrous structure in a cribriform septum.  $\times 300$ .
7. The direction of the fibres in a septum and synaptica on either side; the dark wavy lines are connective tissue.  $\times 300$ .
8. Part of the end of a septum with fibres resolved into crowds of spicules; tubes of *Achlya penetrans*, nobis, are parasitic.  $\times 400$ .

## PLATE VI.

- Fig. 1. *Halomitra crustacea*. The corallum.
2. Fracture removing one septum from its neighbour, showing perforate base-wall, upright stout synaptica joining together by cross pieces; above are the ornamental granules of the free septal edge.  $\times 3$ .
3. Another view, showing a stout massive synapticulum.  $\times 3$ .
4. Part of a calice, showing synaptica from above.  $\times 2$ .
5. The perforated base, from below.  $\times 2$ .
6. *Herpolitha limosa*. A fracture, showing synaptica and basal perforations.
7. Synaptica, seen from above, between granular septa.
8. } Microscopic views of the spicules of *Fungia scutaria*, var.  $\times 600$ .
9. } Diameter of spicule  $\frac{1}{1000}$  inch.
10. }

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On the Pairing of *Tegenaria Guyonii*, Guér., with a Description of certain Organs in the Abdominal Sexual Region of the Male. By F. MAULE CAMPBELL, F.L.S.

[Read February 1, 1883.]

(PLATES VII. & VIII.)

PAIRING OF *TEGENARIA GUYONII* (Guér.).

The relation between the palpi and abdominal sexual organ of male Spiders was discovered by Menge ("Ueber die Lebensweise

der Arachniden," *Neueste Schriften der naturf. Gesellsch. Danzig*, vol. iv. 1843); and he describes the deposition of semen and its collection in the cases of *Agelena labyrinthica*, Clerck, and *Linyphia triangularis* (? *L. scalarifera*, Menge, or *L. emphana*, Walck.\*). A. Ausserer ("Beobachtungen über die Lebensweise, Fortpflanzung und Entwicklung der Spinnen," *Zeitschr. Ferdinandeums*, 1867) gives corresponding details as to *Linyphia triangularis*, Clerck, and *Dictyna benigna*, Walck. M'Cook ("Pairing of Spiders, *Linyphia marginata*," *Proc. Acad. Nat. Sci. Philadelphia*, 1879) appears to have seen the same process in *L. marginata*; and Blackwell briefly notes the alternate application of the palpal organs of *Agelena labyrinthica* to a "milk-white fluid" which was speedily imbibed. Bertkau ("Ueber den Generationsapparat der Araneiden," *Arch. Nat. Gesch.* 1875, p. 254) has related his observations on *Philoica domestica* and *Linyphia montana*. I am not aware of any other account of this primary sexual act, which, in consequence of its short duration, can only be witnessed through good fortune or the most constant attention.

The varied forms of the palpi of male spiders, and their length relatively to their distance from the opening of the abdominal sexual organ, suggest the great probability of more or less difference in the process according to the species. The character of the palpi must also govern the mode of actual union, which in the case of *Tegenaria Guyonii* has also not hitherto been described.

*The Deposition of Semen.*—A male *T. Guyonii* which had been imprisoned a month cast its skin on the 28th of July and gained maturity. I did not observe it make any movement until the 5th of August; and three blowflies which had been given it remained untouched. On that day I placed the bottle which contained it uncovered inside another in which was a female. She had been mature a fortnight. The male soon became conscious of her presence, and approached her. Wishing to see if his attention could be diverted by food after his long abstinence, and fearing he might attack the female, I dropped close to him a daddy-long-legs, which he quickly seized. The following morning he was standing with the first pair of legs over the female and his maxillæ resting on her abdomen, while she was crouching motionless with her head in an opposite direction. Both were

\* See Thorell's 'Remarks on Synonyms of European Spiders,' p. 48.

in the same position the next morning (7th August, 7 A.M.). A 10 A.M. he became restless, and wandered, with spinnerets extended, about the bottle, returning every now and then to place his palpi on the female. After each such occasion he jerked his abdomen upwards and downwards, a movement\* which I have often noticed in males, both mature and immature, and which gives the idea of an expression of impatience. I was called away for a few minutes, and on returning found the male about two inches behind the female, standing as it were on tip-toe. The palpi were now placed alternately and nervously to the maxillæ. On their removal the whole body was raised still higher, and the abdomen brought nearly to a right angle with the cephalothorax, with considerable muscular effort in the basal portion and with violent tremulations. The movements, which were repeated four times, had the effect of throwing the spider slightly forward, while the palpi were shaken in that peculiar manner which denotes great muscular tension in some other part than that in visible motion. The palpi were now (generally alternately) placed under the sternum, and moved backwards and forwards, upwards and downwards with a scooping motion. In five minutes these movements of the abdomen and palpi were repeated ten times in regular succession, only varied by an occasional transfer of the digital organs to the mouth. It was only during the last moments of the process that reflected light enabled me to see a triangular silken sheet attached to the spider behind the abdominal sexual organ by its apex, and by its external angles to the mesh across the bottle. The sheet extended from under the abdomen to the anterior part of the sternum and lay *above* the palpi. The male now left the sheet and approached the female; but she appeared mindless of his addresses. I now seized him; and in his attempts to evade capture he injured the silken sheet. An examination showed that the sides consisted of many shreds (fig. 19, A), while the intervening space was covered with an irregular mesh (fig. 20, natural size), which was doubtless originally more systematically arranged. Here and there was a mass of semen containing a fine granulated substance (fig. 19, B) of great refractive power. The whole was in a very liquid state, and spermatozoa were arranged singly above the threads.

\* This suggests one of the causes of the development of the abdominal and thoracic stridulating organs in certain species. See Journ. Linn. Soc., Zool., "On supposed Stridulating Organs of *Steatoda guttata*, Wider.," p. 152, vol. xv.

Immediately after the spider was secured, one of its palpi was removed. The vesiculum seminis was charged with spermatozoa even to the embolos (figs. 1, 2, 3, and 4, E), where they were plainly seen at intervals (fig. 4, *Spe*). I could not, however, discover any on the external parts of the palpus.

I have been unable to gather from the accounts of other species any idea of the motion of the palpi in collecting the semen, except that in some cases they were alternately applied. The large spoon-shaped cavity of the palpi (figs. 1 and 2, A) of *Tegenaria Guyonii* renders this point of interest. These organs were placed *under* the silken sheet; and their movements were like those of a hand under a network striving to secure any substance which was there by causing it to fall through the meshes. It seemed as if the semen were being shaken into the cavity A previous to its collection by the embolos, the concave spatulated opening of which (figs. 3 and 4) is well adapted for the entrance\*.

*The Pairing.*—This species, according to Blackwell (= *T. domestica*, Blackw., *British Spiders*, p. 164) and Simon (= *T. parietina*, Frc., 'Les Arachnides de France,' vol. ii. p. 61), pair in May. It is of course possible that broods may overlap each other, or that locality may alter the season; but if I may judge from the number of individuals which arrive at maturity in this neighbourhood during July and August, the comparative frequency of wandering males in that period and their scarcity in May, I must call the end of summer the height of the breeding-season. The eggs are laid the following spring.

I observed thirteen couples pairing in confinement from the middle of July to the end of August; and the following account may be taken as typical of the species, with this exception, that the union does not necessarily occur so quickly after the female has gained maturity.

On the 13th of August I placed together a male and a female. On the 17th the latter cast her last skin. Up to that time, 6 A.M., they had taken no notice of one another. At 9.45 P.M. the two were so close together that the femora of the first pair of legs of each were almost in contact. After a few convulsive twitches of the legs, the male pressed forwards, moving his palpi

\* Menge ('Preussische Spinnen,' p. 25) has seen, in the cases of *Linyphia*, *Agalena*, *Lycosa*, the semen collected from the sheet by structures analogous to the cavity A, and called by him the spermophorum.

up and down, when, as they touched the palpi of the female, the pair played with these organs like two friendly bees with their antennæ. After a few minutes the female raised herself, leaning a little on her left side, and the male crept forward until his head was under the sternum of his mate, while his first pair of legs were resting upon hers. He now advanced his right palpus, leaning a little to the left and using the left palpus as part of his support. The right palpus was slightly twisted so as to bring the surface drawn in fig. 1 opposite the sexual organ of the female, while the joints below the humeral were directed obliquely outwards and downwards. The digital joint seemed to lie in such a position that, if moved upwards and forwards, the groove G (figs. 1 and 2) would come in contact with the right bursa copulatrix, E\*, fig. 21. I have but little doubt that the embolos was by this time transferred from its usual resting-place along the rim of the cavity A to the groove G (figs. 1 and 2). The male now rapidly raised his palpus up and down for four or more seconds, and with such energy as to compel the female to assume a vertical position. He then retired, and again approached her, repeating the movements to a greater or less number, occasionally pausing before he withdrew his palpus with a slight twist inwards. At times he would leave the female for five minutes, and strut with straightened legs round the vase wagging his abdomen. Now and then he would remain perfectly still with the palpus withdrawn, or play with the palpi of the female while she seemed in a comatose state. He would then renew the union with undiminished vigour, appearing on each occasion less desirous of changing his position. I left them at 12.30 A.M. and returned at 7 A.M. The male was still using his right palpus. I saw no application of the left palpus, but have no doubt that it was employed during the night as in other cases. I have not observed the pairing ever interrupted by a fresh collection of semen, although there is no reason to think that this may not occur. The duration of the pairing is long; but I am inclined to think it is more dependent on the difficulty in inserting the embolos than on sexual endurance. The impregnation appeared to take place when the male retained his palpus in front of the bursæ copulatrices for about thirty seconds, which was frequently the case. Ausserer, in describing the pairing of *Epeira diadema* ('Zeitschrift des Ferdinandeums,' Dritte Folge, pt. xiii. 1867, p. 199), seems to

confirm this; for he remarks that the male was only a second by the female, but adds:—"Ich glaube kaum dass da der Same in die Samentaschen des Weibchens gelangen könnte, wesshalb ich diesen Vorgang als blöses Vorspiel zur eigentlichen Begattung betrachte." In order to be sure that I had witnessed the absolute coupling, I examined two females which had cast their skin thrice in confinement, and had afterwards consorted with the male as above related. The spermatheca were charged with spermatozoa, but were not so full as if a few weeks had elapsed after their impregnation.

*General Remarks.*—The sedentary habits of these spiders (*Tegenaria Guyonii*) render them well suited for confinement; but their general avoidance of light is not favourable to observation. The males are the least susceptible in this respect; and their wandering habits may be the cause. Females will resort to the darkest corners of a shaded square glass case. I exposed to the light one of this sex in such a vessel 10 inches square and 6 inches high. She lined each side of her prison with sheets of silk, as if she had attempted to darken it.

With a view to better examination, I have several times moved to sunlight a pairing couple; but the female would resist the continued addresses of the male until again in shade, and on the gradual admission of light she would retire.

The sudden disappearance of the males of many species lead to the conclusion that they die shortly after the fulfilment of their sexual destiny. Such is not the case with *Tegenaria Guyonii*; for I have seen one male in union with three females during twenty days in August. He was healthy in December when killed for dissection. The males are, however, rarely procurable in winter; but this cannot be said of the other sex. It would therefore appear that either the females are more numerous during the breeding-season, or that the males are shorter lived. Darwin ('Descent of Man,' p. 255, 2nd ed.) states that he was informed by Blackwell that males are more numerous than females with a few species, but that in several species out of six genera the reverse appears to be the case. He also refers ('Descent of Man') to Thorell ('On European Spiders,' p. 205) "speaking as if female spiders were generally commoner than males;" but the context of the passage shows that Thorell was alluding to the difficulty of obtaining mature males of all species, and the consequent objection to basing specific distinction on their palpi. The

only data I have are not sufficient to form a conclusion as to the *T. Guyonii*; but out of ten young ones caught in July and August, seven now show the swollen palpi of an immature male.

On a few occasions during the pairing-season I have found a male on the top of a cob on which was a recently cast exuvium, while the owner, an immature female, had retreated below. In one case the semen was protruding from the abdominal sexual organ of the male. Thinking that some light might be thrown on the probable case of parthenogenesis in this species (Journ. Linn. Soc., Zool. vol. xvi. p. 536), I removed the pair to separate vases, and after a few days put them together. The male at once (Aug. 19th, 10 A.M.) began to pay his addresses. Shortly afterwards he rapidly applied one of his palpi to the female in the manner already described, and apparently with her consent. At 3 P.M. he charged her, tore away two legs below the trochanter and began to suck one, using the mandibles to hold the limb just as a human being would a stick of asparagus. The female died an hour afterwards. The sexual parts were much deranged, and the opening of the oviduct exposed; but she required another moult to be mature. Fig. 23 represents the state of the undeveloped bursæ copulatricæ\* denuded of hairs. There were no more chitinous parts than those coloured red. The prolongations (fig. 21, C B\*, C B) of the chitinous plate, which in the mature stage pass forwards to the spermatheca, were only represented by a narrow fold of skin; while the spermatheca were but recognizable as small cones without any convolutions about a fourth of the mature length. I carefully examined for spermatozoa, but could find none. I have now in confinement two females which, when in a similar immature stage, were placed with males; but the season has not arrived for knowing the result. In neither case did I observe anything but a very laggard courtship on the part of the males.

Wishing to see how the males would act, I placed three of them on different occasions in a glass vase in which were only a cob and a recently cast exuvium of a female in its natural position. It was interesting to see them searching for something as soon as they felt the threads. Having found the exuvium, they cautiously felt below the web with their legs, as if to see whether

\* The female sexual organ, immediately after maturity, is not so chitinous as fig. 21, and somewhat resembles fig. 23; but all the parts are developed, which was not the case with the above spider.

the former occupant was at home. They would then walk away a few inches only to turn back with obstinate repetition, to satisfy themselves after a closer search that they were not mistaken. These spiders, like many others, usually remove their recently cast skin from a web they continue to inhabit almost as soon as their strength enables them; so that the males were justified in thinking that the exuvium indicated the presence of another spider.

The case just mentioned of a male killing an immature female cannot be explained by her supposed sexual incapability. I have seen two males similarly dismember their spouses an hour or so after impregnation\*. Hunger could not have been the cause; for all were well fed. One of them partook of a daddy-long-legs and two blowflies during the thirty-six hours previous to his attack. In fact males† in confinement take their food much better than females; and this may be due to their being accustomed to feed during their sexual excursions in places which are strange to them. I have only twice seen a female *Tegenaria Guyonii* drive away the male, and in each case immediately after union, as has often been related of many species. On the other hand, I have kept an adult pair together from the 22nd of August to the 28th of October, and they lived in perfect amity. The male never ceased paying unrequited attentions except to feed. One male was so ferocious that I had immediately to remove on different occasions two young adult females which I had placed with him.

These cases are interesting, inasmuch as they are the converse of authenticated accounts of females of other species attacking the male immediately after his caresses. I have never considered this action otherwise than one to be expected from a creature without gregarious habits, and which must regard weaker forms of animal life as food, or as an inconvenience, if we except its young or its mate when in the act of pairing. Those instincts, which are habitually practised throughout the far greater portion of the life of the species, and on which its existence depends, would

\* In all these cases there was no regular cobweb, but only a silken sheet spun at the bottom of the vase.

† They appear to require an occasional drop of water in the vessel which confines them. I have not seen them touch it; and suppose a damp atmosphere is needed. For an account of a female drinking, see Journ. Linn. Soc., Zool., vol. xvi. p. 537.



scarcely be suspended for a longer period than necessary for the sexual union. Spiders frequently eat one another; and such an occurrence after pairing is only curious if considered apart from their habits. When the sexual desire is satiated, their actions would be again directed by the dominant instinct of destruction, which would be stronger if a general excitement be supposed to follow the union.

The excellent means which spiders such as *T. Guyonii* possess of measuring each other's strength when on the same web by the tension and motion of the threads, are calculated to prevent an attack except by the stronger or through blind fury. Now the comparative size of the sexes of this species varies considerably\*. It is not unusual to find a large male, with its longer legs, much more formidable in appearance than a small female of recent maturity; and such was the case in the three attacks on the female and in the lengthened courtship above mentioned.

The same caution or, one might say, self-restraint shown by spiders in hesitating before springing on a hopelessly entangled defenceless insect larger than their usual prey, seems equally displayed in conflicts between themselves. Blind fury is not therefore always the actuating impulse.

It will be observed that the attack, when made by a female, often follows the union immediately, while that of the three males took place some time afterwards. The explanation appears to be this:—The action of a female when satiated would be precipitated by the threatened and unacceptable continued application of the hard spiny palpus, while the more lasting desire of the male would have to subside before he became directed by another

\* Simon ('Les Arachnides de France,' vol. ii. pp. 60 & 61) gives the following measurements:—

♂. Ceph., length 8·5 mm., breadth 7; legs, 1st 74·5, 2nd 63·6, 3rd 45, 4th 58·2.

♀. Ceph., length 8 mm., breadth 6; legs, 1st 46, 2nd 40·2, 3rd 36, 4th 44. Abd., long. 11, larg. 8.

♂ min. Ceph. long. 4·5; ♀ min., long. 6.

The wandering sexual excursions of the males may have developed the greater length of legs, while the necessary additional weight of the abdomen of females must have affected the cause and sum of natural selection in this respect. The ordinary habits are the same with both sexes.

The sexual excursions of the *Argyronetica aquatica* may have been a larger factor in the development of the greater size of the male as compared with the female. The passage *through* water, which is the habitat, would require more strength than on land.

instinct. By that time, when in a free state, other attractions, if not his wandering disposition, would take him away from the web. Even if he again approached her, and she were the weaker, there would be ample opportunity for an escape by the lower tube of her cob, as collectors know to their loss. So long as the females are not injured, the benefits to the species, both in size and strength, are obvious when males capable of effecting more than one impregnation are sufficiently powerful to prevent an attack.

The Rev. O. P. Cambridge (Proc. Zool. Soc. 1871, p. 621, see also 'Descent of Man,' p. 273, 2nd ed.) ascribes the extreme smallness of the male in the genus *Nephila* to the chances of escape from the female being in favour of a diminutive race of males. This at first sight appears antagonistic to the opinions I have advanced; but natural selection will have effected different degrees of correlation between agility and size according to the habits and early form of the species.

Our Secretary Mr. Romanes ('Animal Intelligence,' p. 205) has referred to these sexual conflicts, and suggests the courage and determination required of the male may be of benefit to the species by instilling these qualities into his descendants. I would add that the capture or escape after union of males capable of effecting more than one impregnation would develop agility and strength; for those which were *maladroit* or weak would be eliminated. The attack by the female would also be of specific advantage, for it is but another form of that vigour which is so profitably directed against the larger kinds of prey.

#### CERTAIN ORGANS IN THE MALE ABDOMINAL SEXUAL REGION.

The external abdominal sexual region is marked by a slight convexity, in front of which is placed transversely a row of transparent spines (fig. 7, S S). Two papilla-like processes are situated just above the opening of the ejaculatory duct\* (fig. 7, P, P\*). Neither of these organs have hitherto been noticed.

\* Each vas deferens opens into a sinus which passes backwards and downwards, and unites with its fellow to form a common chamber in front of the groove traversing the ventral surface of the abdomen between the openings of the pulmonary sacs. The chamber opens out on the anterior portion of the groove in a transverse slit. Fig. 6 represents diagrammatically, in section, the position and course of the vas deferens, sinus, and opening. The incomplete function the chamber which unites the two sinuses, as compared with that of other homologous male sexual organs, seems to render the word penis inapplicable to it. I propose to employ the term ejaculatory duct to the chamber.

The *spines* are tubular, point backwards, and project just beyond the convexity. They generally are twenty-four in number, and are placed singly or in groups of two, three, or four. A basin of varied form surrounds each group or single spine (fig. 8, A\*, B, C, D). A tube runs from each spine, and, after making many and sudden convolutions, ends in a gland of a pear-shaped form. Figs. 9, 10, 12, 13, and 14 represent different sections from about the spines to the ejaculatory duct, E d, passing through several glands and their ducts. Fig. 11 shows a gland with its duct separated from its spine. The contents of the glands have a high refractive power.

The *papillæ* are erectile, and consist of pointed scales surrounding a fascicule of fibres which internally diverge, and (so far as I have been enabled to follow them) are lost in the connective tissue lining the inferior side of the genital sinus. The points of the scales rest on one another, thus giving to the processes a conical form. The position of one papilla with the scales open, P, is seen in fig. 16; and fig. 17 (osmic-acid preparation) shows the internal direction of the fibres. Fig. 15 represents a papilla after having been submitted to pressure in glycerine. In fig. 18 the scales and external portions of the fibres have been removed, and the papilla is drawn *in situ*, as observed when the spider is on its back, the point of view being from behind along the abdomen.

The question arises as to the function of these glands and papillæ. Their position denotes some share in the primary sexual process. They are not found in the females. I have only met with the papillæ (possibly not fully developed) in immature males, during the stage preceding the last ecdysis, when there are no tubular spines. As to the papillæ, I would suggest that their fibres when protruded are used for arranging or supporting the triangular sheet, or for assisting the collection of semen by the palpi. They are conspicuous on the allied species *Tegenaria atrica* and *T. civilis*. It is more easy to limit the conjectures as to the purpose of the glands to two alternatives:— (1) To pour their secretion on the semen when deposited; or (2) to spin threads which would guide the semen to the silken sheet of which they might form a part. The position of these glands is interesting, for it approximates that of the spinning-

\* The bifid form of A seems to show it to be a union of two spines. Only one point was perforated. This is exceptional.

organs of the *Chernetes* (Pseudo-Scorpiones). They are also found, with some modification of arrangement, on *T. atrica*, *T. civilis*, *Epeira diadema*, *Amaurobius fenestralis*, and *A. similis*.

I desire particularly to call to these glands the attention of those interested in the anatomy and study of spiders generally. It yet remains to be observed whether they occur in both sexes in other genera, and whether they only are developed in the adult males of other species.

## DESCRIPTION OF THE PLATES.

## PLATE VII.

- Fig. 1. Digital joint of right palpus of *Tegenaria Guyonii*, ♂ (hairs removed). S, sheath; Sp, spermophorum; A, spoon-shaped cavity; G, groove; E, embolos; R s, ribbed surface; T, tentaculum, which is probably used for holding the female. × 15.
2. Spermophorum, embolos, and tentaculum. (Letters as above.) × 40.
  3. Opening of embolos. × 255.
  4. Opening of embolos: *Spe*, spermatozoa. × 150.
  5. Junction of testis with vas deferens.
  6. Diagrammatic longitudinal section of male abdominal sexual organ. E d, ejaculatory duct; P, papilla-like process; S S, tubular spines.
  7. View from below of male abdominal sexual organ (somewhat diagrammatic). × 80.
  8. A, bifid spine and basin; B, two spines with common basin in section; C, common basin of four spines (cut short); D, single spine (cut short) and basin. × 220.
  9. Vertical transverse section of male abdominal sexual organ through spines and ejaculatory duct. S S, tubular spines; C, the convoluted ducts; G, G, G, glands; E d, ejaculatory duct; *Spe*, spermatozoa. × 80.
  10. Section as above, showing base of spines, convoluted ducts, and G, G\* two glands. × 250.
  11. Gland and duct leading to one of four spines with common base. The gland was torn on removal of connective tissue. × 250.
  12. Vertical longitudinal section of male abdominal sexual organ. A, A, connective tissue traversing glandular region; B, B, connective tissue surrounding the glandular region; G, G\*, G\*, glands; P, papilla-like process; E d, ejaculatory duct; A M, one of the diverging groups of muscles which run from the external skin to the inferior side of the ejaculatory duct; D, part of a muscle in connexion with the ejaculatory duct. × 75.

## PLATE VIII.

13. Vertical transverse section. V S, ventral surface; A M, group of diverging muscles which run from external skin to the inferior side of the

ejaculatory duct E d ; F, F\*, the attachments of two muscles with the external skin a little in front of the ejaculatory duct. The muscles run backwards to the inner corner of each opening of pulmonary sac.  $\times 75$ .

- Fig. 14. Vertical longitudinal section of muscles A M. V S, ventral surface ; G, glands.  $\times 75$ .
15. Papilla after pressure in glycerine. The fibres project.  $\times 570$ .
  16. Right papilla, as viewed from below. The scales are open, P.  $\times 570$ .
  17. Vertical longitudinal section of papilla and fibres.  $\times 570$ .
  18. Right papilla, with scales and external portion of fibres removed. The Spider has been turned on its back, and the view is taken from behind along the abdomen.  $\times 570$ .
  19. Spermatozoa on the silken sheet: A, the border of the sheet.  $\times 570$ .
  20. Sheet on which spermatozoa were deposited, natural size. (Deranged.)
  21. Bursæ copulatrices of female *T. Guyonii* (hairs removed). B, chitinous band ; C B, C B\*, prolongations of band leading to spermatheca ; C, thin skin ; E and E\*, entrances to spermatheca.  $\times 15$ .
  22. Bursæ copulatrices of female *T. Guyonii* (hairs removed). The muscles &c. have been removed to show position of spermatheca. Letters as above, the arrows point to the entrances of the spermatheca.  $\times 40$ .
  23. Sexual organ of immature female *T. Guyonii* referred to on p.168.  $\times 15$ .
  24. Vertical longitudinal section of muscle F, F\* (fig. 13), showing the fibres *f* which cause the depression on each side of the convexity of abdominal sexual region, ♂. V S, ventral surface.
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